Please type a plus sign (+) inside this box → +

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))

Attorney Docket No.	679P01US
First Inventor or Application Identifier	S. Dell'Aera
Title	Radio Calibration by Correcting the Crystal Frequency
Express Mail Label No.	

ADDRESS TO: Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

JC925 U.S. PTO 09/702691 11/01/00

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. [X] * **Fee Transmittal Form** *(e.g., PTO/SB/17)*
   (Submit an original and a duplicate for fee processing)

2. [X] **Specification** [*Total Pages* 18]
   (preferred arrangement set forth below)
   - Descriptive title of the Invention
   - Cross References to Related Applications
   - Statement Regarding Fed sponsored R & D
   - Reference to Microfiche Appendix
   - Background of the Invention
   - Brief Summary of the Invention
   - Brief Description of the Drawings *(if filed)*
   - Detailed Description
   - Claim(s)
   - Abstract of the Disclosure

3. [X] **Drawing(s)** *(35 U.S.C. 113)* [*Total Sheets* 5]

4. **Oath or Declaration** [*Total Pages* 2]
   - a. [ ] Newly executed (original or copy)
   - b. [ ] Copy from a prior application (37 C.F.R. § 1.63(d))
     (for continuation/divisional with Box 16 completed)
     - i. [ ] **DELETION OF INVENTOR(S)**
       Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).

NOTE FOR ITEMS 1 & 13: IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).

5. [ ] Microfiche Computer Program *(Appendix)*

6. Nucleotide and/or Amino Acid Sequence Submission
   (if applicable, all necessary)
   - a. [ ] Computer Readable Copy
   - b. [ ] Paper Copy (identical to computer copy)
   - c. [ ] Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

7. [ ] Assignment Papers (cover sheet & document(s))
8. [ ] 37 C.F.R. §3.73(b) Statement [ ] Power of Attorney *(when there is an assignee)*
9. [ ] English Translation Document *(if applicable)*
10. [ ] Information Disclosure Statement (IDS)/PTO-1449 [ ] Copies of IDS Citations
11. [ ] Preliminary Amendment
12. [X] Return Receipt Postcard (MPEP 503) *(Should be specifically itemized)*
13. [ ] * Small Entity Statement(s) (PTO/SB/09-12) [ ] Statement filed in prior application, Status still proper and desired
14. [ ] Certified Copy of Priority Document(s) *(if foreign priority is claimed)*
15. [ ] Other: ....
    ....
    ....

16. If a CONTINUING APPLICATION, *check appropriate box, and supply the requisite information below and in a preliminary amendment:*

[ ] Continuation [ ] Divisional [ ] Continuation-in-part (CIP) of prior application No: _____/_____

Prior application information: Examiner _____ Group / Art Unit: _____

For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

17. CORRESPONDENCE ADDRESS

[ ] Customer Number or Bar Code Label
(Insert Customer No. or Attach bar code label here)
or [X] *Correspondence address below*

Name	Pascal & Associates
Address	P.O. Box 3440
	Station D
City	Ottawa	*State*	Ontario	*Zip Code*	K1P 6P2
Country	Canada	*Telephone*	(613) 820-1366	*Fax*	(613) 820-1553

Name (Print/Type)	Harold C. Baker	*Registration No. (Attorney/Agent)*	19333
Signature		*Date*	Oct 31/00

FEE TRANSMITTAL
for FY 2000

Patent fees are subject to annual revision.
Small Entity payments **must** be supported by a small entity statement,
otherwise large entity fees must be paid. See Forms PTO/SB/09-12.
See 37 C.F.R. §§ 1.27 and 1.28.

Complete if Known	
Application Number	unknown
Filing Date	on even date
First Named Inventor	S. Dell'Aera
Examiner Name	
Group / Art Unit	
Attorney Docket No.	679P01US

TOTAL AMOUNT OF PAYMENT ($)

METHOD OF PAYMENT (check one)

1. ☐ The Commissioner is hereby authorized to charge indicated fees and credit any overpayments to:

Deposit Account Number: 16-0600

Deposit Account Name: Pascal & Associates

☒ Charge Any Additional Fee Required Under 37 CFR §§ 1 16 and 1 17

2. ☒ Payment Enclosed:
☒ Check ☐ Money Order ☐ Other

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Fee ($)	Small Entity Fee Code	Fee ($)	Fee Description	Fee Paid
101	690	201	345	Utility filing fee	710.
106	310	206	155	Design filing fee	
107	480	207	240	Plant filing fee	
108	690	208	345	Reissue filing fee	
114	150	214	75	Provisional filing fee	

SUBTOTAL (1) ($) 710.

2. EXTRA CLAIM FEES

	Extra Claims	Fee from below	Fee Paid
Total Claims 15 -20** =		X	=
Independent Claims 3 - 3** =		X	=
Multiple Dependent			=

**or number previously paid, if greater; For Reissues, see below

Large Entity Fee Code	Fee ($)	Small Entity Fee Code	Fee ($)	Fee Description
103	18	203	9	Claims in excess of 20
102	78	202	39	Independent claims in excess of 3
104	260	204	130	Multiple dependent claim, if not paid
109	78	209	39	** Reissue independent claims over original patent
110	18	210	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($)

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Fee ($)	Small Entity Fee Code	Fee ($)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet.	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for reply within first month	
116	380	216	190	Extension for reply within second month	
117	870	217	435	Extension for reply within third month	
118	1,360	218	680	Extension for reply within fourth month	
128	1,850	228	925	Extension for reply within fifth month	
119	300	219	150	Notice of Appeal	
120	300	220	150	Filing a brief in support of an appeal	
121	260	221	130	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive - unavoidable	
141	1,210	241	605	Petition to revive - unintentional	
142	1,210	242	605	Utility issue fee (or reissue)	
143	430	243	215	Design issue fee	
144	580	244	290	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Petitions related to provisional applications	
126	240	126	240	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	
146	690	246	345	Filing a submission after final rejection (37 CFR § 1.129(a))	
149	690	249	345	For each additional invention to be examined (37 CFR § 1.129(b))	

Other fee (specify) _____

Other fee (specify) _____

SUBTOTAL (3) ($)

* Reduced by Basic Filing Fee Paid

SUBMITTED BY

			Complete (if applicable)	
Name (Print/Type)	Harold C. Baker	Registration No. (Attorney/Agent) 19333	Telephone	613 820-1366
Signature			Date	Oct 31/00

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Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

RADIO CALIBRATION BY CORRECTING THE CRYSTAL FREQUENCY

FIELD OF THE INVENTION:

This invention relates to radios and crystals used in radio. Specifically, the invention relates to methods and devices used to calibrate radio crystals and to correct for errors in the crystal frequency or errors due to Doppler effects.

BACKGROUND TO THE INVENTION:

Modern equipment which use radio waves for communications, such as cellular telephones, generally operate at very high frequencies. These devices use frequency synthesizers to produce the high frequencies required. However, crystals are still needed for the high stability frequency they produce. Frequency synthesizers, such as phase locked loop (PLL) frequency synthesizers phase lock with the highly stable signals of crystals to produce stable high frequency signals.

Essentially, frequency synthesizers, especially PLL frequency synthesizers, phase lock with a crystal signal and multiplies the frequency of that crystal signal to produce a utilizable high frequency stable signal. Thus, the high frequency signal used by the radio equipment is a multiple of the crystal frequency. It should be noted that the multipliers used by frequency synthesizers are not limited to integers. Fractional-N frequency synthesizers can use fractional numbers as multipliers. This feature allows highly accurate frequencies to be produced.

During production, radios have to be tuned to perform at expected frequencies. However, tuning radios to the proper frequency can be time consuming and expensive. Frequently, radios have a tunable component

which is adjusted to obtain the correct frequency by a technician during production.

One problem with crystals is that, under certain conditions, the frequency of their signals tend to drift away from the expected frequency. The phase of the crystal signal is still stable; however, the frequency may now be different. Temperature, age of the crystal, and other known factors can cause this unfortunate phenomenon. When this occurs, given that the high frequency signal generated by the frequency synthesizer is a multiple of the crystal frequency, the high frequency signal drifts as well. This can lead to poor transmission and/or reception between radios as the frequency being used is no longer the desired frequency. To remedy this problem, periodic calibration of radios is performed. This entails adjusting the crystal frequency to obtain the correct high frequency signal. Clearly, such methods can be expensive, requiring time consuming disassembly of radios and shop time for technicians to perform the calibration.

Another measure currently in use to compensate for frequency drift in crystals is the use of Voltage Controlled Temperature Compensated Crystal Oscillator (VCTCXO). Using a VCTCXO, the new frequency after drift is determined to be higher or lower than the desired frequency. After this determination, a correction voltage is sent to the VCTCXO to compensate for the drift. However, for the most part, radio manufacturers allow their crystals to drift without correction or compensation. To minimize the possibility of such drifts, manufacturers can use more expensive crystals which are either less prone to drift or which do not drift as much.

Another problem with radios concerns the well

known and well documented Doppler effect. Given two communicating radios, with at least one radio in motion relative to the other, the transmission frequency perceived by either radio from the other is constantly

5   changing. This frequency varies as the velocity between the two radios changes. Clearly, the changing frequency perceived by either of the two radios makes for problematic transmissions.

What is therefore needed is a method and an
10   apparatus that allows for fast and inexpensive calibrations of radios. Also needed is a method which compensates for Doppler effects.

SUMMARY OF THE INVENTION:

15   The present invention provides a simple and inexpensive method of calibrating radios. By implementing the invention in a lab or production facility, quick, automatic calibrations are possible. Furthermore, the invention allows for automatic

20   calibrations and corrections for crystal drift without extensive shop time or technician time.

The present invention automatically corrects for crystal frequency drift by determining the true crystal frequency. Once the true crystal frequency has been

25   measured and calculated, the proper multiplier required to produce a desired frequency can easily be found and implemented. The present invention allows for a constantly changing desired frequency without recalibration and without readjusting the crystal

30   frequency once the true crystal frequency is known. Once the true crystal frequency is found, a proper multiplier can be calculated to produce the desired frequency, what ever that may be. Continuously adjusting the multiplier thus allows for a changing

desired frequency, thereby facilitating clear communications between radios, regardless of whether they are in motion or not.

In one embodiment, the present invention provides a method of calibrating a radio having a frequency source which produces a first signal having a first frequency by multiplying a second signal having an original frequency by a multiplier value, the method comprising determining the original frequency, utilizing the original frequency to determine a corrected multiplier value, and producing an output signal having an output frequency approximately equal to a desired frequency by adjusting the multiplier value to the corrected multiplier value.

In another embodiment, the present invention provides a method of adjusting an output frequency of a signal produced by a frequency source, the said frequency source producing the signal by multiplying an input signal having an original frequency by a multiplier value, the method comprising:

aa) measuring a preliminary frequency of the signal

ab) adjusting the multiplier value based on the original frequency and a measurement of the preliminary frequency to produce a corrected multiplier value

ac) outputting a signal having an intermediate frequency based on the corrected multiplier value

ad) repeating steps aa) to ac) to obtain a final signal with a final frequency such that a difference between the final frequency and the desired frequency is a minimum.

In a third embodiment, the invention provides a device for adjusting an output frequency of a signal produced by a frequency source comprising:

- a frequency source which produces the signal
5   by multiplying:

         - an input signal having an input frequency and

         - a multiplier having a value

- a controller coupled to the frequency source,
10   said controller controlling the value of the multiplier

- a frequency measurement device coupled to the frequency source, said frequency measurement device measuring the output frequency of the
15   signal and producing measurement data relating to the output frequency of the signal

wherein the controller is coupled to receive the measurement data produced by the frequency measurement device.

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BRIEF DESCRIPTION OF THE DRAWINGS:

A better understanding of the invention will be obtained by considering the detailed description below, with reference to the following drawings, in which:

25   Figure 1 is a block diagram illustrating the main components of a hardware implementation of the invention;

Figure 2 is a flow chart detailing the different steps of one embodiment of the invention;

30   Figure 3 is a flow chart detailing the different steps of a second embodiment of the invention;

Figure 4 is a flow chart detailing the different steps of a third embodiment of the invention; and

Figure 5 is a more detailed block diagram of a

5

hardware implementation of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT:

Referring to Figure 1, a block diagram of a
hardware implementation of the invention is illustrated.
A controller 10 is coupled to a frequency source 20
which, in turn, is coupled to a frequency measuring
device 30. The frequency source 20 is controlled by the
controller 10. The controller 10 controls the
multiplier by which the frequency source 20 multiples
the input frequency 40 to produce the output frequency
50.

To determine the input frequency 40, one need
only know the output frequency 50 and control the
multiplier supplied by the controller 10. The
controller 10 sets the multiplier to a known value and
uses this known multiplier value so that the frequency
source 20 produces a signal with an output frequency 50.
This signal with the output frequency is accurately
measured by the frequency measuring device 30. The
measurement data produced by the frequency measuring
device 30, which is a measurement of the output
frequency 50, is sent to the controller 10. Since the
controller 10 knows the multiplier value used by the
frequency source 20 to produce the output frequency 50,
the controller 10 can easily calculate the value of the
input frequency 40. This is done simply by dividing the
value of the output frequency 50 by the known multiplier
value, yielding the true input frequency.

Once the true input frequency is known, the
controller can thereby calculate the multiplier value
required by the frequency source 20 to produce a signal
with an output frequency 50 approximately equal to a
desired frequency 60. Once this corrected multiplier

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value is found by the controller 10 by dividing the desired frequency the true input frequency, the corrected multiplier is transmitted to the frequency source 20 so that it can be used to produce the desired
5   frequency.

At this point, the radio device utilizing the invention is calibrated as the controller 10 and the frequency source 20 will continue to use the corrected multiplier value until the input frequency 40 or the
10   desired frequency 60 changes. If desired, the true input frequency can be stored in suitable storage means, such as a read only memory (ROM), for future use.

Figure 2 illustrates the logic flow diagram followed by the controller 10 described above.

15   If the input frequency 40 changes or drifts, perhaps because of the age of a crystal producing the signal with the input frequency 40 or because of temperature effects, the output frequency 50 also changes. This new output frequency 50 is measured by
20   the frequency measuring device 30 and is communicated to the controller 10. The controller 10 then compares the measured new output frequency 50 with the desired frequency 60. If the difference between the desired frequency 60 and the new output frequency 50 is not
25   within preprogrammed tolerances, the controller 10 calculates a new multiplier based on the new output frequency 50. Once this new multiplier value is used by the frequency source 20, the radio device is once again properly calibrated as it produces approximately the
30   desired frequency 60. If the difference between the output frequency 50 and the desired frequency 60 is not within tolerance limits, the calibration starts all over.

Once the difference between the output frequency

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50 and the desired frequency 60 is within tolerance limits, the input frequency 40 can now be found. The output frequency 50 is divided by the new multiplier to obtain the input frequency. This input frequency can then be stored in suitable storage means, such as a ROM, for future use.

A logic flow diagram followed by the controller 10 is illustrated in Figure 3.

In another embodiment of the invention, the controller 10 can be used to compensate for a changing desired frequency 60. If, as mentioned above, the radio equipment utilizing the invention is in motion relative to another piece of radio equipment it is communicating with, the output frequency 50 must continually change as the frequency required to communicate with the other piece of radio equipment changes. This means that the desired frequency 60 is constantly changing. When this occurs, the controller 10 must continuously compare the output frequency 50 measured by the frequency measuring device 30 with the changing desired frequency 60. Depending on whether the output frequency 50 is higher or lower than the desired frequency 60, the controller 10 adjusts the multiplier value accordingly. If the output frequency 50 is higher than the desired frequency 60, the multiplier value is lowered from its previous value. Alternatively, if the output frequency 50 is lower than the desired frequency 60, the multiplier value is increased from its previous value.

The amount by which the multiplier value is incremented or decremented can be preprogrammed into the controller. Thus, by having the controller 10 continuously sample, compare, and either increase or decrease the multiplier value, the output frequency 50 approaches the desired frequency 60. This process can

terminate once a final output frequency is found. Such a final output frequency is a frequency that, if not exactly equal to the desired frequency, is within tolerance limits to the desired frequency.

The above embodiment can also be used to determine the original or input frequency 40 that was multiplied by a multiplier to synthesize the output frequency 50. Once the final output frequency has been obtained by the above method, the multiplier value used to obtain that final output frequency is noted. The final output frequency is then divided by that multiplier value to determine the original or input frequency 40. This original or input frequency can then be stored in suitable storage means for future use. Once the true original frequency is known, changes in the desired frequency 60 can be accommodated by adjusting the multiplier value.

The logical flow diagram followed by the controller 10 in implementing the above is shown in Figure 4.

Alteratively, the controller 10 can be programmed to find the correct multiplier in one iteration of the method. Given a desired frequency 60 and a true input frequency, the controller 10 can skip numerous iterations by simply, as above, dividing the desired frequency 60 by the input frequency 40 to obtain the appropriate multiplier value. While this method may seem more efficient, if the desired frequency 60 is continuously increasing or continuously decreasing, depending again on the Doppler effect, incrementing or decrementing the multiplier value by a set value may be more computationally efficient.

A more detailed block diagram of a possible embodiment of the invention is pictured in Figure 5. In

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this embodiment, the frequency source 20 is a high resolution PLL frequency synthesizer which uses a Delta Sigma modulator 70. The delta sigma modulator 70 allows the use of multiplier values having both an integer part 80 and a fractional part 90. Such a frequency source provides an ideal source for high performance radio equipment and is ideally suited for this invention. A Delta-Sigma PLL frequency synthesizer would be ideally suited for this invention as the Delta-Sigma PLL frequency synthesizer allows for high resolution multipliers, thereby allowing for a correction of small errors in the original frequency. However, it should be noted that any high resolution frequency synthesizer with a controllable multiplier would be suitable for use in this invention.

It should be noted that the controller 10 referred to above can be implemented using well known processors. A dedicated microcontroller or a dedicated general purpose central processing unit can be implemented inside radio equipment to perform the controller functions. In this case, the software required to control the logic of the processor would be resident in a non-volatile memory such as read-only-memory (ROM) with the true input frequency and the multiplier value being stored in either a rewritable non-volatile memory such as an electronically erasable programmable read only memory (E^2PROM) or, for a less expensive implementation, in random access memory (RAM). However, for mobile applications, where the invention is resident in a radio, the preferred method of storing the true original frequency is a ROM. In such a case, moving from one wireless network that uses one frequency to another that uses another frequency, would only involve changing the true original frequency by either

replacing the ROM.

In a production facility implementation of the invention, to be used to calibrate mass numbers of radios, the controller 10 could be a general purpose computer such as a personal computer. An appropriate interface between the controller 10, which in this implementation would be external to the radio equipment, allows the controller 10 to send multiplier values to the frequency source 20 resident in the radio equipment. Once the calibration has been completed, the controller can either send the true original or input frequency 40 to the radio or the radio can determine the true original or input frequency 40 from the multiplier value. In this implementation, the frequency measurement device 30 would also be external to the radio equipment.

The frequency measurement device 30, in either an internal radio implementation or a production facility implementation, is a suitable high resolution device. In a production facility, suitable frequency counters or spectrum analyzers can serve as frequency measurement devices. In mobile applications, numerous methods or devices can be used. If a radio base station transmits a reference signal, suitable hardware can determine whether the output frequency of the radio is higher or lower than the reference signal. Obviously, the higher the resolution and the better the accuracy of the frequency measuring device, the more accurate and hence the more useful the invention.

The input frequency can be supplied by a crystal which oscillates at a certain frequency. This option is illustrated in Figure 5.

It should also be noted that the invention can be implemented on a single integrated circuit. All the

components listed above, including the code which runs the controller 10, can be stored on a single application specific integrated circuit (ASIC).

A person understanding the above-described invention may now conceive of alternative designs, using the principles described herein. All such designs which fall within the scope of the claims appended hereto are considered to be part of the present invention.

I claim:

1.   A method of calibrating a radio having a
frequency source which produces a first signal having a
first frequency by multiplying a second signal having an
original frequency by a multiplier value, the method
comprising:

     a)   determining the original frequency

     b)   utilizing the original frequency to
             determine a corrected multiplier value

     c)   producing an output signal having an
             output frequency approximately equal to a
             desired frequency by adjusting the
             multiplier value to the corrected
             multiplier value

2.   A method as claimed in claim 1 wherein step a)
further includes the steps of:

     a1)   measuring the first frequency

     a2)   dividing the first frequency by the
             multiplier value to obtain the original
             frequency.

3.   A method as claimed in claim 1 wherein step b)
further includes the steps of dividing the desired
frequency by the original frequency to obtain the
corrected multiplier value.

4.   A method as claimed in claim 1 further including

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the step of storing the original frequency in storage means.

5.   A method as in claim 1 wherein the frequency source is a high resolution frequency synthesizer.

6.   A method as in claim 5 wherein the second signal is provided by a crystal oscillating at the original frequency.

7.   A method of adjusting an output frequency of a signal produced by a frequency source, said frequency source producing the signal by multiplying an input signal having an original frequency by a multiplier value, the method comprising:

aa)   measuring a preliminary frequency of the signal

ab)   adjusting the multiplier value based on a desired frequency and a measurement of the preliminary frequency to produce a corrected multiplier value

ac)   outputting a signal having an intermediate frequency based on the corrected multiplier value

ad)   repeating steps aa) to ac) to obtain a final signal with a final frequency such that a difference between the final frequency and the desired frequency is a minimum.

8.   A method as claimed in claim 7 wherein step ab)
further includes a step chosen from the group
comprising:

      ab1)   incrementing the multiplier value by a
              preprogrammed value to obtain the
              corrected multiplier value if the
              preliminary frequency is lesser than the
              desired frequency

      ab2)   decrementing the multiplier value by a
              preprogrammed value to obtain the
              corrected multiplier value if the
              preliminary frequency is greater than the
              desired frequency

      ab3)   utilizing the multiplier value as the
              corrected multiplier value if the
              preliminary frequency is approximately
              equal to the desired frequency.

9.   A method as claimed in claim 7 further including
the step of obtaining the original frequency by
dividing the final frequency by the corrected
multiplier value.

10.   A method as claimed in claim 9 further including
the step of storing the value of the original frequency
in a storage means.

11.   A device for adjusting an output frequency of a
signal produced by a frequency source, the device
comprising:

- a frequency source which produces the signal
by multiplying:
  - an input signal having an input frequency
  and
  - a multiplier having a value

- a controller coupled to the frequency source,
said controller controlling the value of the
multiplier

- a frequency measurement device coupled to the
frequency source, said frequency measurement
device producing measurement data relating to
the output frequency of the signal

wherein the controller is coupled to receive the
measurement data produced by the frequency measurement
device.

11.   A device as claimed in claim 10 wherein the
frequency source is chosen from the group comprising:

  - a high resolution frequency synthesizer
  - a radio

12.   A device as claimed in claim 10 wherein the
controller is chosen from the group comprising:

  - a general purpose microprocessor
  - a microcontroller
  - a general purpose personal computer

13.   A device as claimed in claim 10 wherein the
frequency source, the controller, and the frequency
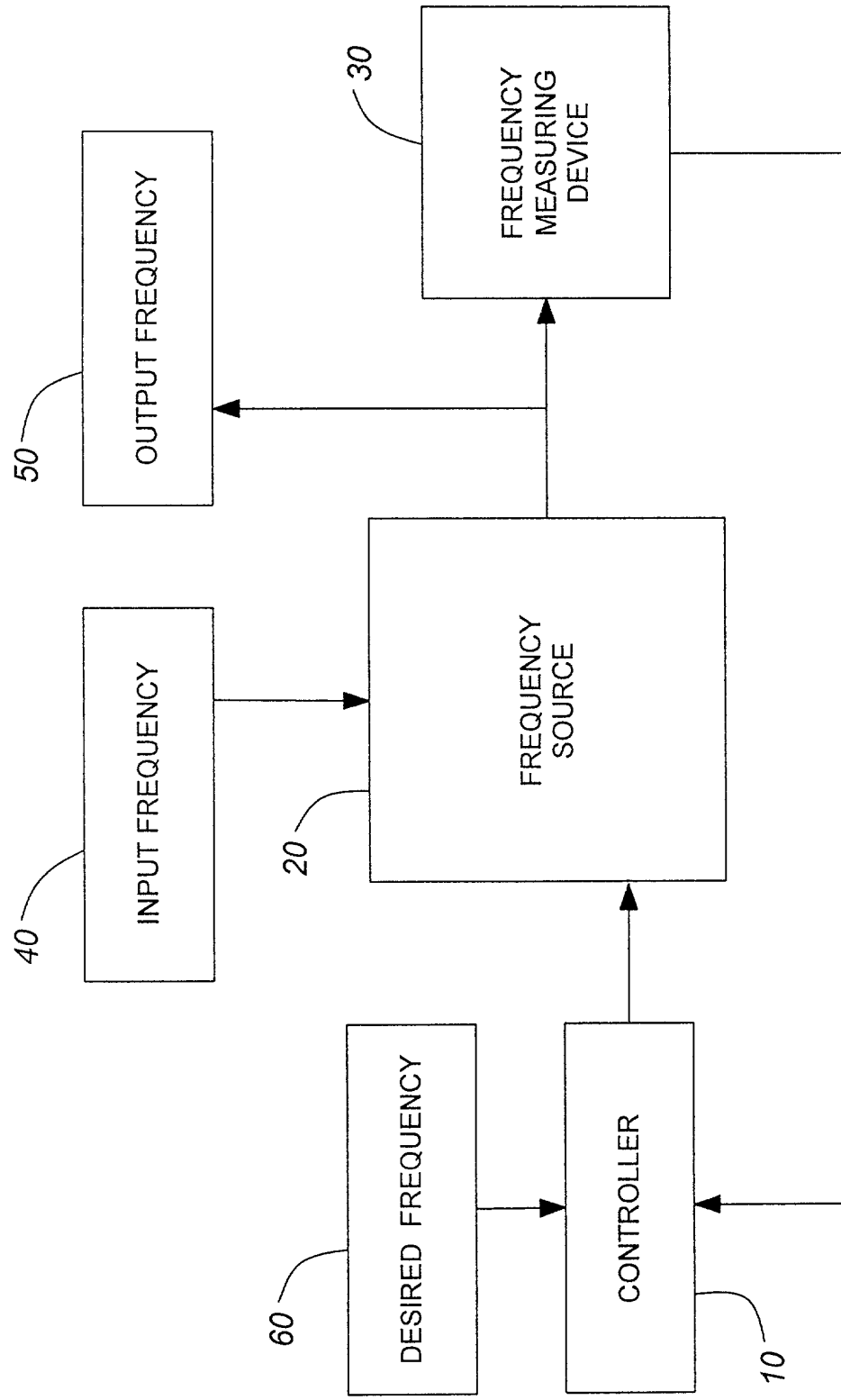
measurement device are implemented on a single
application specific integrated circuit.

14.   A device as claimed in claim 10 further
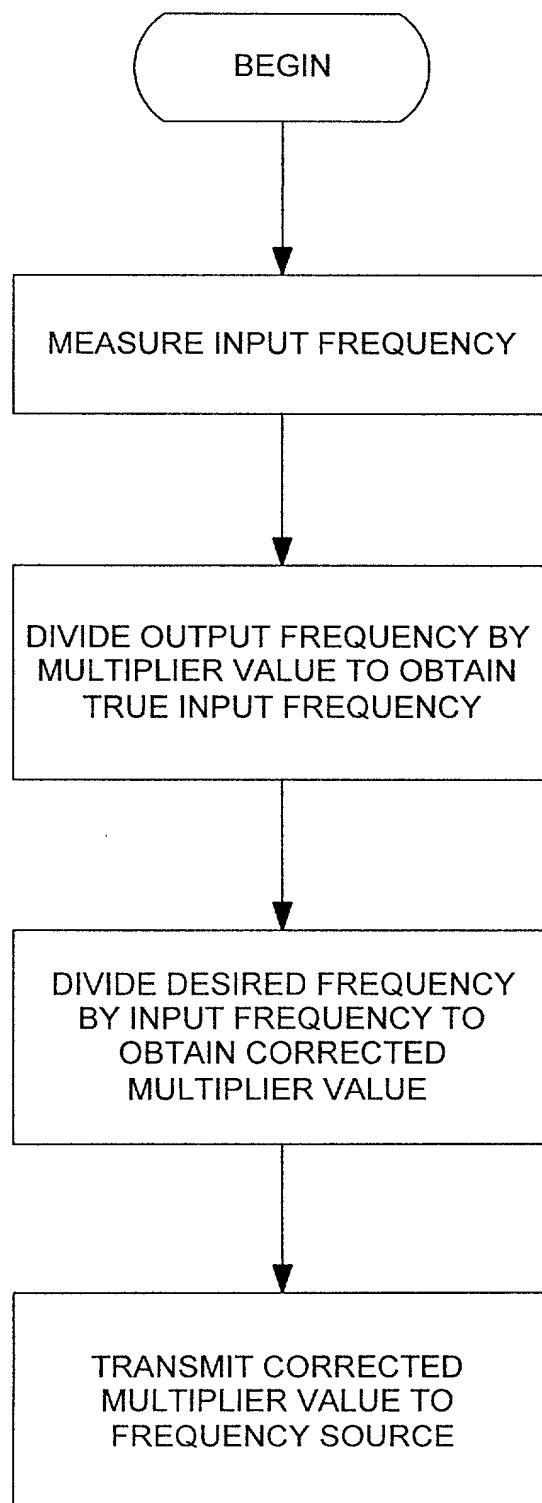including storage means for storing the input frequency.

15.   A device as claimed in claim 10 wherein the
frequency measurement device measures the output
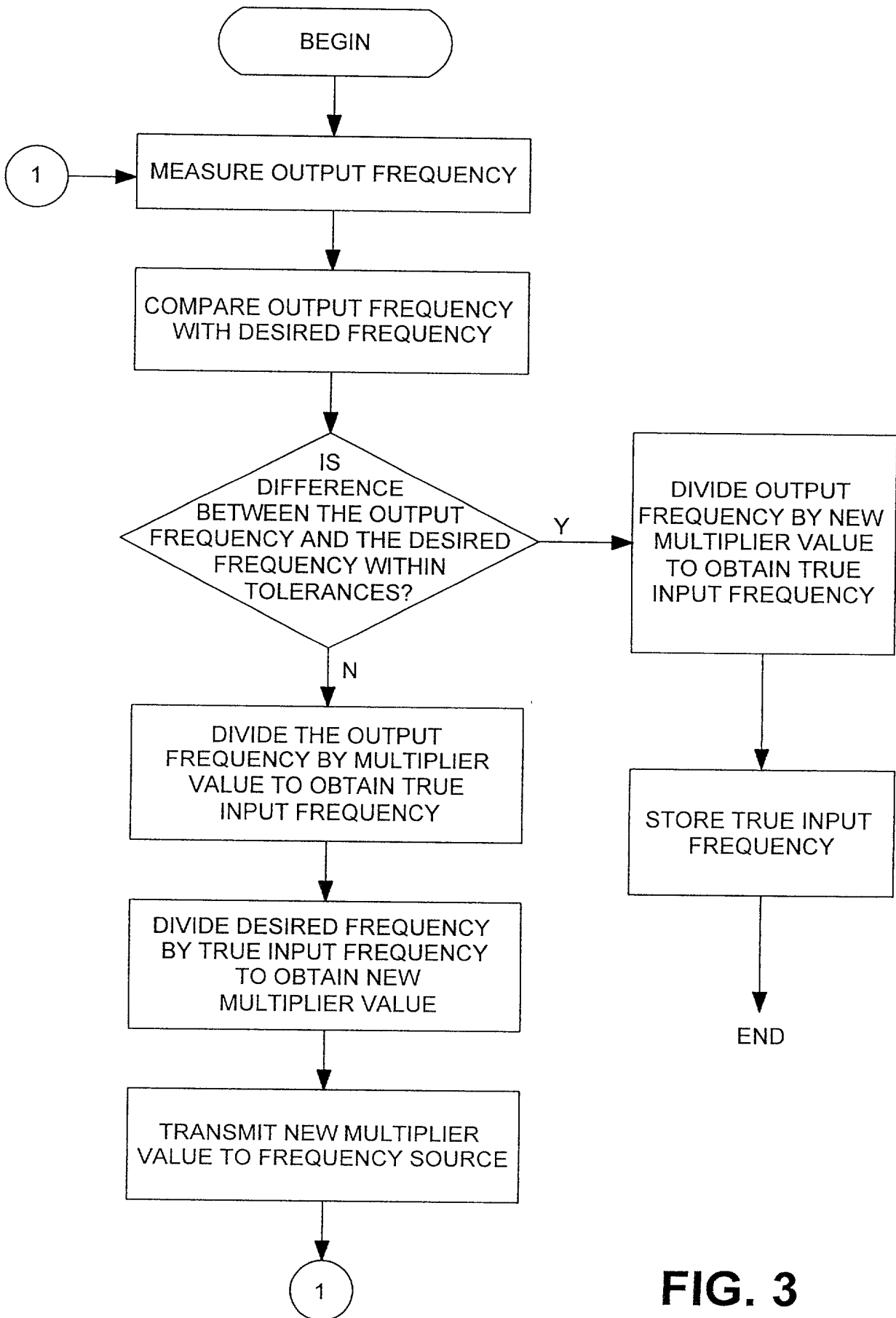frequency of the signal.

ABSTRACT

The present invention provides a simple and inexpensive method of calibrating radios. The present invention automatically corrects for crystal frequency drift by determining the true crystal frequency. Once the true crystal frequency has been measured and calculated, the proper multiplier required to produce a desired frequency can easily be found and implemented. The present invention allows for a constantly changing desired frequency without recalibration and without readjusting the crystal frequency once the true crystal frequency is known. Once the true crystal frequency is found, a proper multiplier can be calculated to produce the desired frequency. Continuously adjusting the multiplier thus allows for a changing desired frequency, thereby facilitating clear communications between radios, regardless of whether they are in motion or not.
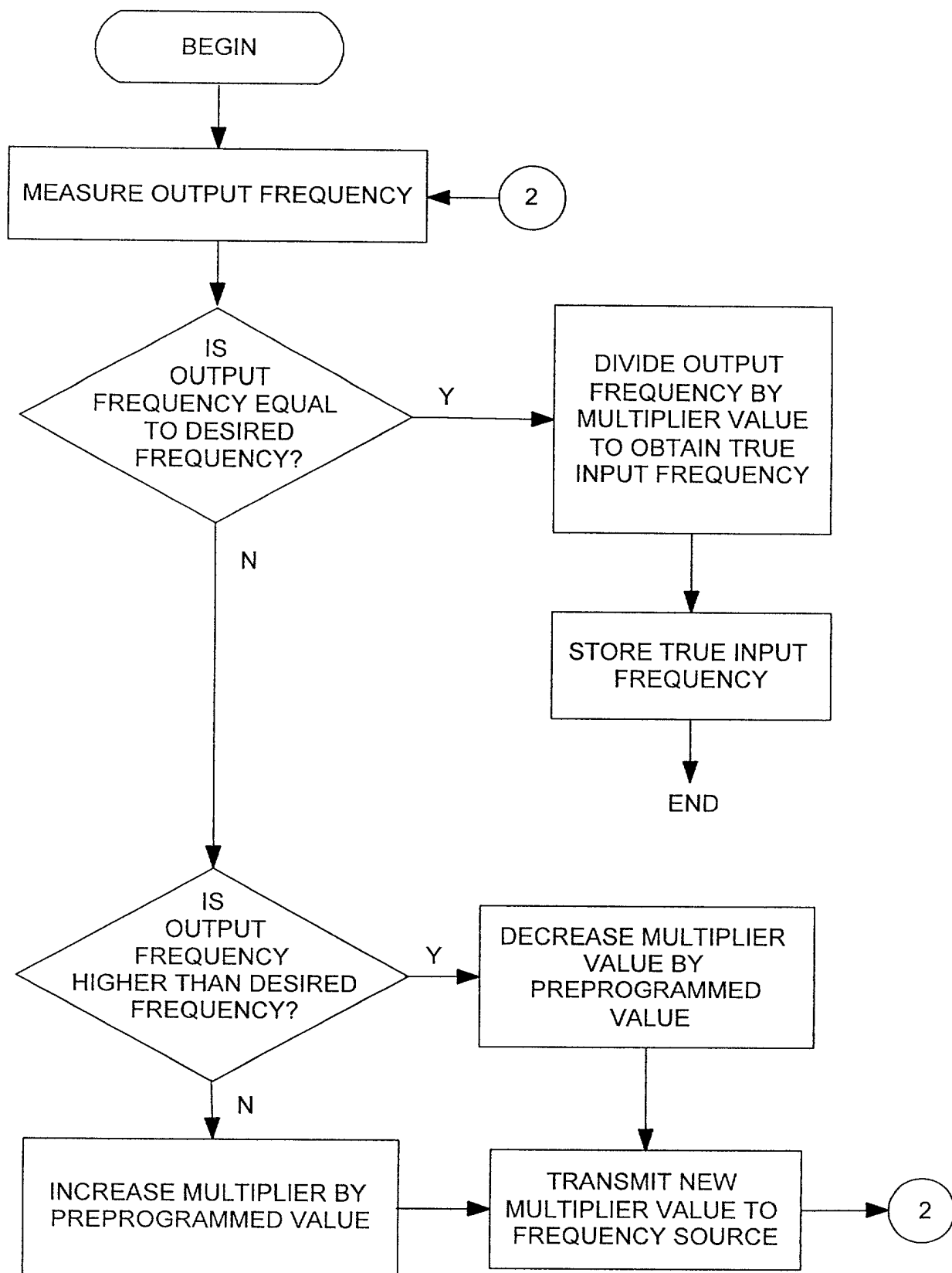
INPUT FREQUENCY
40

OUTPUT FREQUENCY
50

FREQUENCY SOURCE
20

FREQUENCY MEASURING DEVICE
30

DESIRED FREQUENCY
60

CONTROLLER
10

FIG. 1

BEGIN

MEASURE INPUT FREQUENCY

DIVIDE OUTPUT FREQUENCY BY MULTIPLIER VALUE TO OBTAIN TRUE INPUT FREQUENCY

DIVIDE DESIRED FREQUENCY BY INPUT FREQUENCY TO OBTAIN CORRECTED MULTIPLIER VALUE

TRANSMIT CORRECTED MULTIPLIER VALUE TO FREQUENCY SOURCE

FIG. 2

FIG. 3

BEGIN

MEASURE OUTPUT FREQUENCY ◄── 2

IS OUTPUT FREQUENCY EQUAL TO DESIRED FREQUENCY?

Y ──► DIVIDE OUTPUT FREQUENCY BY MULTIPLIER VALUE TO OBTAIN TRUE INPUT FREQUENCY

STORE TRUE INPUT FREQUENCY

END

N

IS OUTPUT FREQUENCY HIGHER THAN DESIRED FREQUENCY?

Y ──► DECREASE MULTIPLIER VALUE BY PREPROGRAMMED VALUE

N

INCREASE MULTIPLIER BY PREPROGRAMMED VALUE ──► TRANSMIT NEW MULTIPLIER VALUE TO FREQUENCY SOURCE ──► 2

FIG. 4

FIG. 5

DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)	Attorney Docket Number	679P01US
	First Named Inventor	Della'Aera
	COMPLETE IF KNOWN	
	Application Number	/
	Filing Date	on even date
☒ Declaration Submitted with Initial Filing OR ☐ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)	Group Art Unit	
	Examiner Name	

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

RADIO CALIBRATION BY CORRECTING THE CRYSTAL FREQUENCY

the specification of which   *(Title of the Invention)*

☒ is attached hereto
     OR
☐ was filed on (MM/DD/YYYY) [   ] as United States Application Number or PCT International

Application Number [   ] and was amended on (MM/DD/YYYY) [   ] (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	NO
2,288,495	Canada	11/02/1999	☐	☐	☐
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)	
		☐ Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

DECLARATION — Utility or Design Patent Application

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. 112. I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: ☐ Customer Number [_____] → *Place Customer Number Bar Code Label here*
OR
☒ Registered practitioner(s) name/registration number listed below

Name	Registration Number	Name	Registration Number
R.A. Wilkes	28170		
H.C. Baker	19333		
R.G. Hendry	22927		

☐ Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto.

Direct all correspondence to: ☐ Customer Number or Bar Code Label [_____] OR ☒ Correspondence address below

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor:	☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any])	Family Name or Surname
Seste	Della'Aera

Inventor's Signature		Date	
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☐ Additional inventors are being named on the ____ supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto